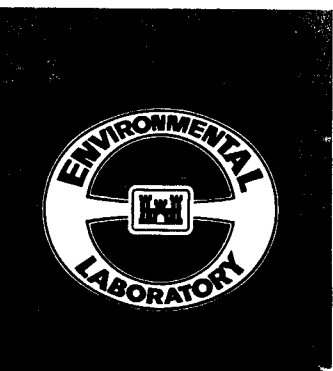
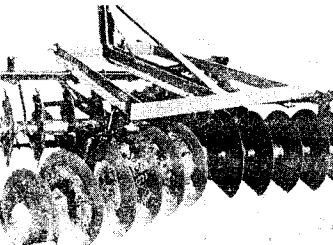
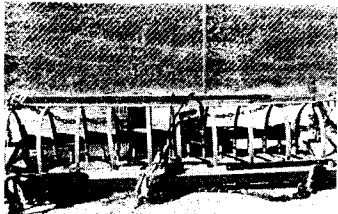




**US Army Corps
of Engineers**



ENVIRONMENTAL IMPACT

Statement of Work

TECHNICAL REPORT EL-86-35

DISK PLOWS AND DISK HARROWS

Section 8.2.5, US ARMY CORPS OF ENGINEERS
WILDLIFE RESOURCES MANAGEMENT MANUAL

by

Ted B. Doerr

Environmental Laboratory

DEPARTMENT OF THE ARMY

Waterways Experiment Station, Corps of Engineers
PO Box 631, Vicksburg, Mississippi 39180-0631



July 1986

Final Report

Approved For Public Release; Distribution Unlimited

Prepared for DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000
Under EIRP Work Unit 31631

Destroy this report when no longer needed. Do not return
it to the originator.

The findings in this report are not to be construed as an official
Department of the Army position unless so designated
by other authorized documents.

The contents of this report are not to be used for
advertising, publication, or promotional purposes.
Citation of trade names does not constitute an
official endorsement or approval of the use of
such commercial products.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188 Exp. Date: Jun 30, 1986	
1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE			Approved for public release; distribution unlimited.		
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Technical Report EL-86-35			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION USAEWES Environmental Laboratory		6b. OFFICE SYMBOL (if applicable)	7a. NAME OF MONITORING ORGANIZATION		
6c. ADDRESS (City, State, and ZIP Code) PO Box 631 Vicksburg MS 39180-0631			7b. ADDRESS (City, State, and ZIP Code)		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION US Army Corps of Engineers		8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c. ADDRESS (City, State, and ZIP Code) Washington, DC 20314-1000			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
					WORK UNIT ACCESSION NO. EIRP 31631
11. TITLE (Include Security Classification) Disk Plows and Disk Harrows: Section 8.2.5, US Army Corps of Engineers Wildlife Resources Management Manual					
12. PERSONAL AUTHOR(S) Doerr, Ted B.					
13a. TYPE OF REPORT Final report		13b. TIME COVERED FROM _____ TO _____		14. DATE OF REPORT (Year, Month, Day) July 1986	
				15. PAGE COUNT 13	
16. SUPPLEMENTARY NOTATION Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP			
			Disk plows Standard plow Brushland plow		
			Disk harrows Wheatland plow Site preparation		
			Equipment One-way plow Seedbed preparation		
19. ABSTRACT (Continue on reverse if necessary and identify by block number) An equipment report on disk plows and disk harrows is provided as Section 8.2.5 of the US Army Corps of Engineers Wildlife Resources Management Manual. The report is designed to assist the Corps District or project biologist with the selection and use of types of equip- ment and materials available for habitat development and manipulation. Topics covered include description, operation and maintenance, limitations, and availability. Disk plows and disk harrows are pieces of equipment commonly used for primary seedbed preparation. They basically consist of circular cutting blades (disks) set on a common axle or multiple axles attached to a frame. Management objectives for using disk plows and disk harrows are stated, and benefits to wildlife habitat are discussed. The design and assembly of equipment are described and illustrated, and general specifications are provided. Three specialized types of disk plows--the standard plow, wheatland (one-way) plow, and brushland plow--are described and compared. Methods of operation are described, and main- tenance and safety requirements are given. Appropriate cautions and limitations are discussed.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL			22b. TELEPHONE (Include Area Code)		22c. OFFICE SYMBOL

PREFACE

This work was sponsored by the Office, Chief of Engineers (OCE), US Army, as part of the Environmental Impact Research Program (EIRP), Work Unit 31631, entitled Management of Corps Lands for Wildlife Resource Improvement. The Technical Monitors for the study were Dr. John Bushman and Mr. Earl Eiker, OCE, and Mr. Dave Mathis, Water Resources Support Center.

This report was prepared by Mr. Ted B. Doerr, Range Science Department, Colorado State University, Fort Collins, Colo. Mr. Doerr was employed by the Environmental Laboratory (EL), US Army Engineer Waterways Experiment Station (WES), under an Intergovernmental Personnel Act contract with Colorado State University during the period this report was prepared. Mr. Chester O. Martin, Team Leader, Wildlife Resources Team, Wetlands and Terrestrial Habitat Group (WTHG), EL, was principal investigator for the work unit. Mr. Steve Arrington, Rome Industries, Cedartown, Ga., and Mr. Dan W. McKenzie, USDA Forest Service, Equipment Development Center, San Dimas, Calif., supplied equipment information and photographs used in the report. Review and comments were provided by Mr. Martin, WES, and Mr. Larry E. Marcy, Texas A&M University.

The report was prepared under the general supervision of Dr. Hanley K. Smith, Chief, WTHG, EL; Dr. Conrad J. Kirby, Chief, Environmental Resources Division, EL; and Dr. John Harrison, Chief, EL. Dr. Roger T. Saucier, WES, was Program Manager, EIRP. The report was edited by Ms. Jessica S. Ruff of the WES Publications and Graphic Arts Division.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is Technical Director.

This report should be cited as follows:

Doerr, Ted. B. 1986. "Disk Plows and Disk Harrows: Section 8.2.5, US Army Corps of Engineers Wildlife Resources Management Manual," Technical Report EL-86-35, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

NOTE TO READER

This report is designated as Section 8.2.5 in Chapter 8 -- EQUIPMENT, Part 8.2 -- SITE AND SEEDBED PREPARATION EQUIPMENT, of the US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL. Each section of the manual is published as a separate Technical Report but is designed for use as a unit of the manual. For best retrieval, this report should be filed according to section number within Chapter 8.

DISK PLOWS AND DISK HARROWS

Section 8.2.5, US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

DESCRIPTION	3	AVAILABILITY	9
OPERATION AND MAINTENANCE	7	LITERATURE CITED	10
LIMITATIONS	7		

Disk plows and disk harrows are pieces of equipment commonly used for primary seedbed preparation. Various modified plows and harrows can be used to accomplish the following tasks: (1) deep and normal plowing, (2) soil clod pulverization, (3) control of shallowly rooted brush and herbaceous plants, (4) breakup of surface soil compaction, (5) incorporation of soil amendments, and (6) anchoring of straw and hay mulch (Vallentine 1971, Ray 1977, Larson 1980). Disk plows and disk harrows are used throughout the United States for agriculture, forestry, range improvements, strip mine reclamation, and habitat management. Disking aids in the establishment of grazing pastures, rejuvenation of brush-infested rangeland, timber stand management, and development of wildlife food and cover plantings. It is also commonly used to stimulate production of herbaceous foods in existing vegetation, especially for small game such as bobwhite quail (*Colinus virginianus*).

DESCRIPTION

Disk plows and disk harrows are composed of circular cutting blades (disks) set on a common axle or on multiple axles attached to a frame. The frame is pulled behind a crawler dozer or rubber-tired tractor. The number, size, and weight of disks vary depending on the type of site preparation required. Plows and disk harrows have a basic design difference that determines how the soil is manipulated. Plows have 1 disk set (disk gang) that inverts the soil. Plows generally move the soil in one direction, whereas disk harrows have 2 disk gangs that move the soil in opposing directions. This provides a more thorough mixing of the soil and results in greater

plowing efficiency in heavy, dry soils. General specifications for disk plows and disk harrows are given in Table 1.

Three specialized types of disk plows are the standard plow, wheatland (one-way) plow, and the brushland plow. The standard plow is a single gang with no common axle attached to a tire-supported frame (Fig. 1). The disks are slanted, cupped, and mounted closely together. The wheatland plow is a single gang supported on a common axle with upright rather than slanted disks; the plow is pulled on a 35- to 50-deg angle to direction of travel. The standard and wheatland plows are best adapted to gentle terrain and moderately soft and rock-free soils. They are generally not adapted to rough range sites.

The brushland plow has disk pairs that compose the single gang which is not on a common axle. Each disk pair is on a common axle, with the lead disk 28 in. in diameter and the back disk 24 to 26 in. in diameter (Fig. 1). Each disk pair is mounted to the heavy-duty frame by a spring-loaded arm that allows each pair to individually articulate over obstacles as it is being pulled at a 30- to 40-deg angle to the direction of travel. The frame is supported by 3 wheels, 1 forward and 2 mounted on the rear. This design allows the brushland disk to be effective on moderately rocky sites and results in minimum disk breakage.

The disk harrow (offset disk) has a minimum of 2 disk gangs set at opposing angles on a frame supported by tires (Fig. 2). A hydraulic lift assembly adjusts the depth of disk penetration. Modifying disk size, disk spacing, and

Table 1. General specifications for disk plows and disk harrows

Feature	Disk harrows	Standard plows	Wheatland plows	Brushland plow
Width of cut	5.2-48.0 ft	0.8-4.5 ft	3.8-20.0 ft	9.5 ft
Number of disks	12-106	1-6	4-24	14 (7 pairs)
Disk size	16-50 in.	24-30 in.	26-28 in.	24-28 in.
Disk spacing	7-20 in.	9 in.	10 in.	9 in.
Total weight	360-27,000 lb	Variable	1200-8000 lb	6000 lb
Power requirements	14-460 hp	60-70 hp	20-215 hp	40-124 hp

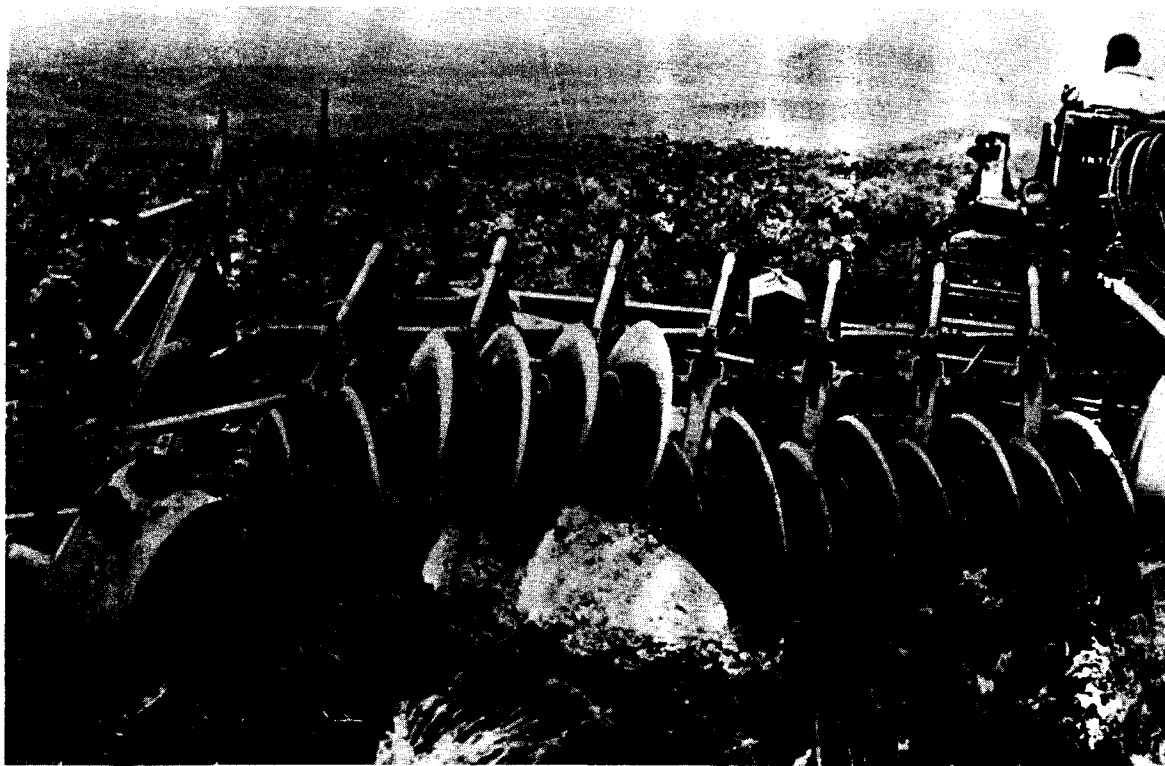
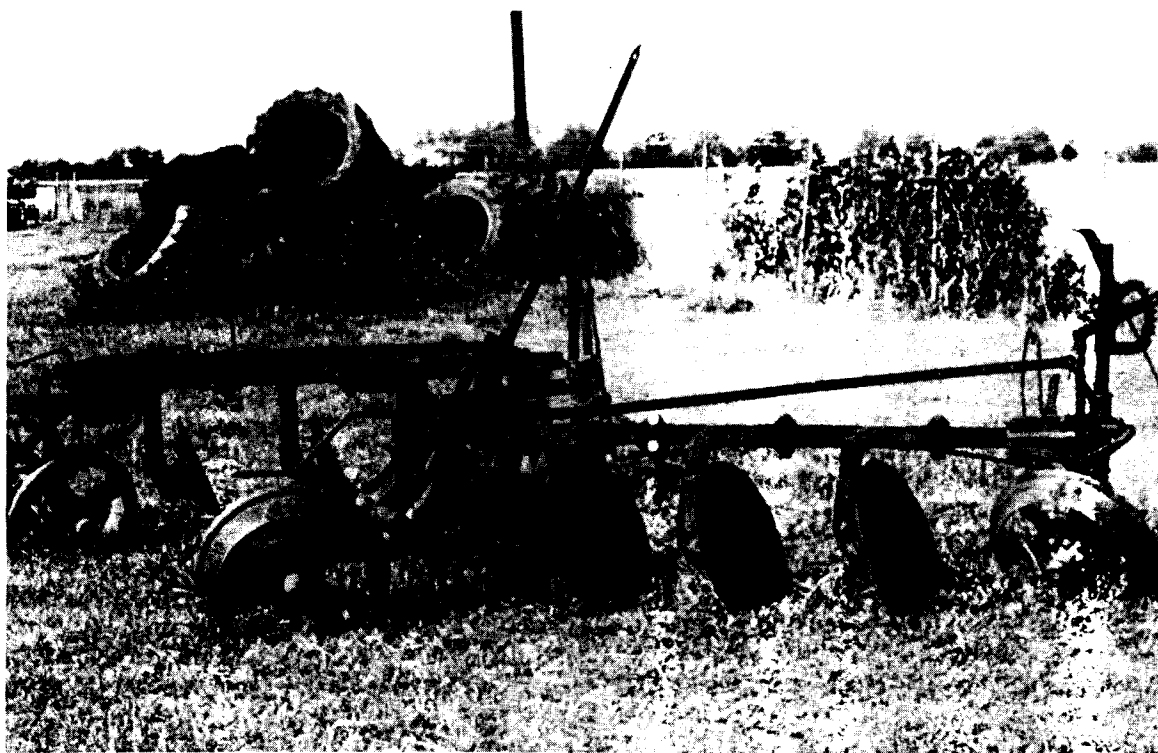


Figure 1. Old model standard disk plow (top) and brushland plow (bottom).
(Brushland plow photo courtesy USDA Forest Service)

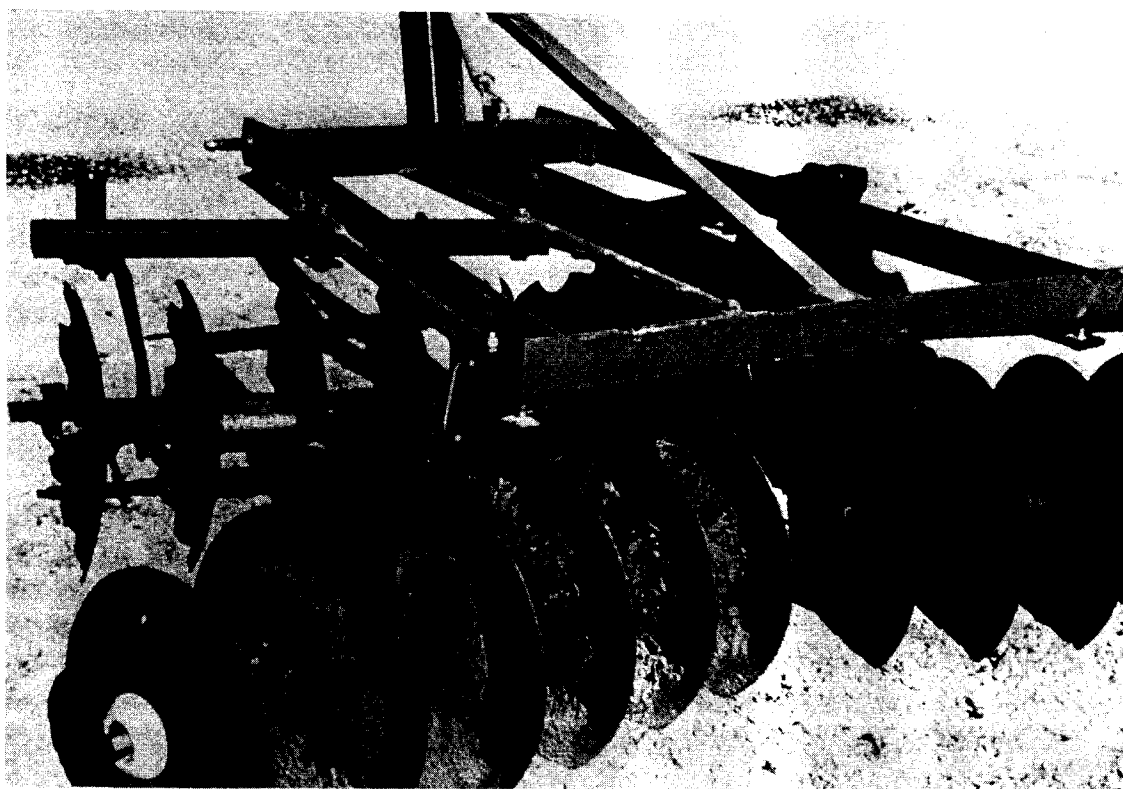


Figure 2. Heavy-duty disk harrow being used for forest site preparation (top), and 48-in.-wide disk harrow commonly used for seedbed preparation on small sites (bottom). (Top photo courtesy of Steve Arrington, Rome Industries)

harrow weight optimizes deep plowing, normal plowing, and pulverizing. Deep plowing requires disks in excess of 30 in. in diameter with each disk carrying a weight greater than 500 lb. Conventional plowing employs disks 26 to 30 in. in diameter with each disk carrying a weight of 200 to 500 lb. Surface soil pulverization uses disks less than 24 in. in diameter that carry less than 200 lb/disk. Notched straight disks increase penetration and pulverization compared to smooth concave disks (Perales 1977, Ray 1977). Also, greater soil penetration is obtained by having wider disk spacing.

OPERATION AND MAINTENANCE

Disk plows and disk harrows are towed behind a dozer or rubber-tired tractor at speeds from 2 to 8 mph depending on implement modification, depth of disk penetration, and site and soil condition. Two passes are recommended for controlling brush species (Larson 1980). Fertilizer and other soil amendments should be broadcast prior to plowing. Plowing should be accomplished on the contours of slopes and perpendicular to the predominant wind direction on level terrain. Adjustments to control the plow depth should be made prior to taking the equipment to the field site. Larger harrows are generally composed of sections that can be folded for ease of transport (Fig. 3).

When selecting a plow or harrow for habitat management, it is important to match the implement to the tractor and to the site treatment required. Suppliers and equipment engineers can assist in determining the best equipment combination to achieve efficient site preparation. General information on harrow modification and matching equipment is given by Foss (1977), Perales (1977), and Ray (1977).

Routine maintenance includes checking bolts, attachments, and hydraulic lines daily for tightness and excessive wear. Lubrication should be carried out weekly. Disks need to be replaced as they wear out or break.

LIMITATIONS

Plows and harrows should always be pulled on the contour and restricted to slopes under 30%. Standard plows have high power requirements and are not adapted to rocky soils. The wheatland plow is also poorly adapted to rough terrain and rocky soils. The brushland plow overcomes the site limitations of the standard and wheatland plow; however, it is limited in availability and

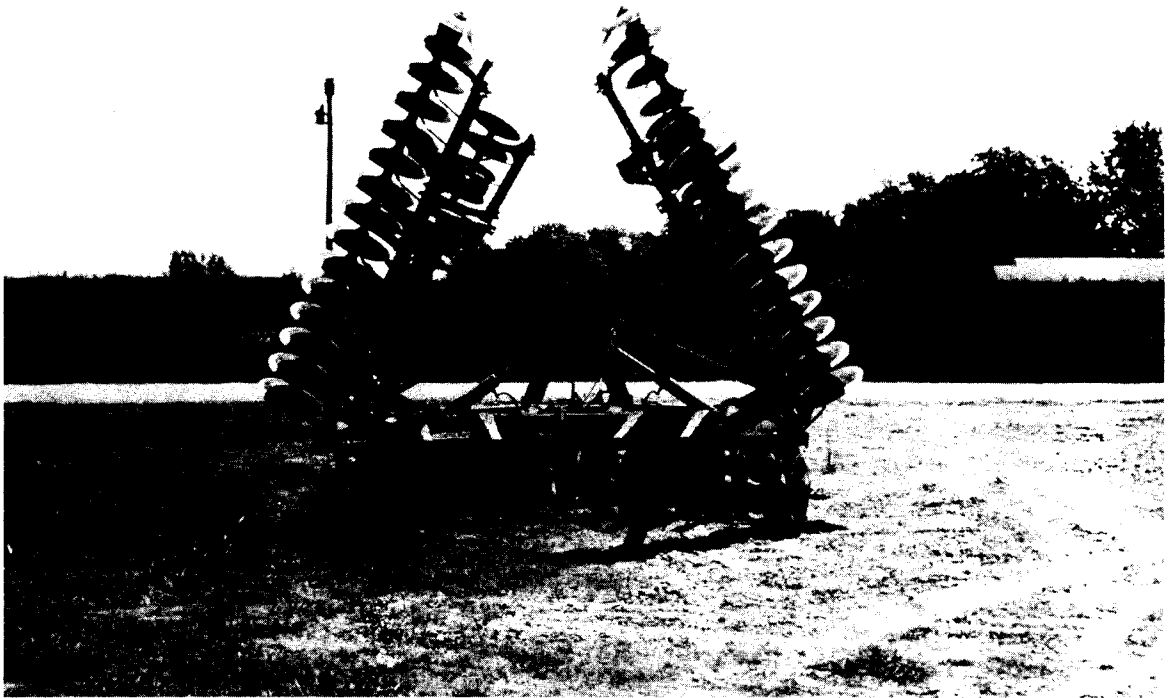


Figure 3. Large disk harrow with sections folded

is difficult to transport because of weight and size. Disk harrows should not be used on areas where large rocks are common.

Two or more passes with disk plows and disk harrows prepare a smooth, homogeneous seedbed that is best suited for establishing special-use pastures composed of only one or two species. However, this type of seedbed may not provide an adequate variety of seed microsites to allow establishment of a diverse plant community necessary for certain types of wildlife habitat development. Chisel plowing may be a more suitable alternative than disk plowing on areas with a high soil erosion potential or on habitat development projects that require a diverse plant community. Another alternative would be to pass over the area only once with a disk plow or harrow so that rough topography would be created; however, only shallow soil penetration would be achieved.

AVAILABILITY

Disk plows and disk harrows are available from most farm implement dealers. The brushland plow is available from:

Laird Welding and Manufacturing Works
Box 1053
531 S. Highway 59
Merced, California 95340

LITERATURE CITED

- Foss, R. A. 1977. Matching implements to tractors. Pages B-1 - B-10 In Product and Marketing Conference. Rome Industries, Cedartown, Ga. 279 pp.
- Larson, J. E. 1980. Revegetation equipment catalogue. USDA For. Serv. Equipment Development Center, Catalogue No. 8042 2501. 198 pp.
- Perales, A. 1977. The importance of proper harrow adjustments. Pages C-1 - C-7 In Product and Marketing Conference. Rome Industries, Cedartown, Ga. 279 pp.
- Ray, J. W. 1977. Rome harrow line. Pages A-1 - A-6 In Product and Marketing Conference. Rome Industries, Cedartown, Ga. 279 pp.
- Vallentine, J. F. 1971. Range Development and Improvements. Brigham Young Univ. Press, Provo, Utah. 516 pp.